(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) **World Intellectual Property Organization**
International Bureau

(43) **International Publication Date**
25 May 2023 (25.05.2023)

WIPO | PCT

(10) **International Publication Number**
WO 2023/089059 A2

(51) **International Patent Classification:**
H01S 5/02255 (2021.01) ***H01S 5/02345*** (2021.01)
H01S 5/02326 (2021.01) ***H01S 5/024*** (2006.01)
H01S 5/0233 (2021.01)

(21) **International Application Number:**
PCT/EP2022/082331

(22) **International Filing Date:**
17 November 2022 (17.11.2022)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**
10 2021 130 370.2
19 November 2021 (19.11.2021) DE

(71) **Applicant: AMS-OSRAM INTERNATIONAL GMBH** [DE/DE]; Leibnizstr. 4, 93055 Regensburg (DE).

(72) **Inventor: NOVAK, Krisztian**; Roter-Brach-Weg 149, 93049 Regensburg (DE).

(74) **Agent: SJW PATENTANWÄLTE**; Goethestraße 21, 80336 München (DE).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

(54) Title: LASER PACKAGE AND METHOD FOR MANUFACTURING A LASER PACKAGE

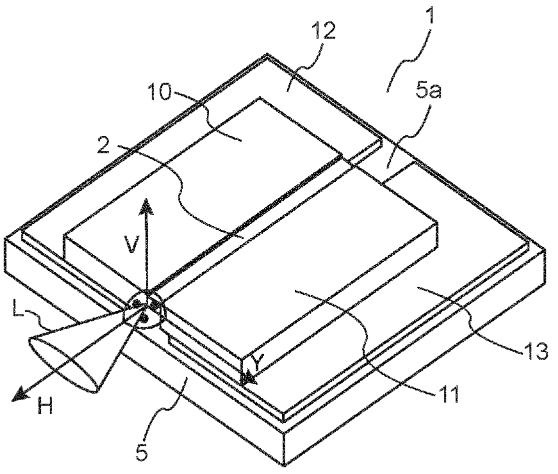

FIG. 2A

(57) **Abstract:** The invention concerns a laser package comprising a baseplate with a first contact layer and a second contact layer arranged on a top surface of the baseplate. The laser package further comprises a first laser diode, in particular high power laser diode, arranged between a first and a second thermally and electrically conductive component, the first component being arranged on the first contact layer and the second component being arranged on the second contact layer. The first laser diode is thereby configured to emit laser radiation through a laser facete arranged on a front surface of the laser diode, the front surface protruding front surfaces of the components, and the laser radiation has a beam profile which is non-rotationally symmetric having a fast axis and a slow axis perpendicular to the fast axis, the fast axis being oriented in parallel to the top surface of the baseplate and the slow axis being oriented perpendicular to the top surface of the baseplate.

WO 2023/089059 A2

LASER PACKAGE AND METHOD FOR MANUFACTURING A LASER PACKAGE

The present invention claims priority from DE application No. 10 2021 130 370.2 dated November 19, 2021, the disclosure of which is incorporated herein in its entirety.

The present invention concerns a laser package and a method for manufacturing a laser package.

Background

Laser diodes, and in particular high-power laser diodes, require good heat dissipation to achieve their full optical performance. Therefore, these components are in general mounted on substrates (heat sinks) with high thermal conductivity. Since the output power of laser diodes is constantly increasing, both the heat sink material and the mounting of the laser diodes on the heat sink material must be improved. With the materials known in the art as well as with the known types of arrangements of the laser diode on the substrate however, such changes cause only minor improvement of the laser packages.

In laser packages known to date, the laser diode is arranged on a so-called submount, for example by means of a gold-tin (AuSn) solder joint. The submount is then arranged on a ceramic substrate, for example by means of gold-tin (AuSn) solder joint, or a silver (Ag) or gold (Au) sintering paste. This solder or sintered compounds together with the submount form a first interface through which the heat generated by the laser diode is dissipated. Wire bonds electrically connected to the side of the laser diode opposite the submount form a second interface through which heat generated by the laser diode is also dissipated. However, heat dissipated by conduction through this interface is neglectable, as well as the dissipation of heat by convection.

To reduce the overall thermal resistance (R_{th}) of the laser package and thus to improve the heat dissipation of the laser diodes, attempts have been made to use materials with improved thermal conductivity for the individual components, as well as to achieve improved heat transfer at the interfaces of the individual components. Due to the many different materials and especially the thermal interfaces of the laser package however, such efforts result in only a limited de-heating possibility.

In addition to this, in laser packages known to date the laser diode needs to be mounted on a submount that comprises such a height that a laser facet of the laser diode has such a vertical distance to the substrate that a light cone emitted by the laser diode through the laser facet does not impinge on the substrate within a predefined horizontal distance from the laser facet. Without the submount, the light cone emitted by the laser diode would however impinge the substrate or another component of the laser package and be "clipped" by it.

This issue in particular exists with downward directed laser diodes which have, for example, an optical element on the substrate downstream in the beam path of the laser diode for deflecting the light emitted by the laser diode. The aim is however to ensure that the light cone emitted by the laser diode hits the optical element in its entirety in order to deflect it without being clipped by the substrate or another component beforehand. Downwardly directed means that the laser diode comprises a laser facet in the lower edge region of the laser diode and the light cone emitted by the laser diode not only radiates in the horizontal direction, but also radiates into an area below the laser diode due to the conical shape of the emitted light with increasing horizontal distance from the laser facet.

Due to the required submount, a reduction of the height of laser packages known to date is limited. In particular for laser packages comprising an optical element on the substrate downstream in the beam path of the laser diode for deflecting the light emitted by the laser diode a reduction of their hight is difficult.

The object of the invention is thus to counteract at least one of the aforementioned problems and to provide a laser package with a reduced thermal resistance as well as with reduced dimensions. It is a further object of the invention to provide a method for manufacturing such a laser package.

Summary

This and other requirements are met by a laser package having the features of claim 1 and a method for manufacturing a laser package having the features of claim 12. Embodiments and further developments of the invention are described in the dependent claims.

The concept, the inventor proposes, is to provide a laser package comprising a first laser diode, in particular high power laser diode, which is arranged between a first and a second thermally and electrically conductive component serving on the one hand side as a heat sinks as well as the electrical contacting of the laser diode. One of the two components contacts the p- and one of the two components the n-side of the laser diode between which an active region is arranged. However, the laser diode between the two components is not arranged on a baseplate in the classic way with its p- or n-side facing the baseplate but rotated by 90° such that the first component and the second component are arranged on the baseplate and the direction of growth of the laser diode is arranged in parallel to the baseplate. Thus, the active region is also rotated by 90° causing the light cone emitted by the laser diode to be rotated by 90° as well. A non-rotationally symmetric beam profile which is having a fast axis and a slow axis perpendicular to the fast axis, wherein the fast axis is in a classical laser package oriented perpendicular to the baseplate, is thus rotated by 90° so that in the concept the inventor proposes the slow axis is oriented perpendicular to the baseplate but not the fast axis. This promotes that within a predefined horizontal distance from the laser diode the light cone emitted by the laser diode does not get clipped by the baseplate even though the laser diode is not arranged on a separate submount.

In addition, a front surface of the laser diode comprising a laser facete through which the laser diode`s radiation is emitted, protrudes front surfaces of the two components. In particular, the laser diode is arranged between the two components, such that it`s front surface is arranged in a different plane then the front surfaces of the two components, wherein in particular the front surface of the laser diode is offset forward with respect to the front surfaces of the two components. Thus, the light cone emitted by the laser diode does not get clipped by the two components as well.

According to at least one embodiment a laser package comprises a baseplate with a first contact layer and a second contact layer arranged on a top surface of the baseplate. A first laser diode, in particular high power laser diode, is arranged between a first and a second thermally and electrically conductive components, the first component being arranged on the first contact layer and the second component being arranged on the second contact layer. The first and the second thermally and electrically conductive component each serve on the one hand as an electrical connection for the laser diode and on the other hand as a heat sink for the heat generated in the laser diode during operation. The first laser diode is configured to emit laser radiation through a laser facete arranged on a front surface of the laser diode, the front surface protruding front surfaces of the components, thus preventing a beam clipping of the laser radiation by the two components. The laser diode is further configured to emit the laser radiation with a beam profile which is non-rotationally symmetric having a fast axis and a slow axis perpendicular to the fast axis, wherein the fast axis is oriented in parallel to the top surface of the baseplate and the slow axis is oriented perpendicular to the top surface of the baseplate, and thus rotated by 90° compared to laser packages known in the art.

By arranging the laser diode between two heat sinks, the heat generated in the laser diode during operation can be better transported out of the laser package. At the same time such an arrangement allows to dispense a submount on which the laser diode is arranged in laser packages known in the art as due to the rotation of the beam profile the laser radiation emitted by the laser diode diverges slower in the vertical direction so that the effect of beam clipping is less critical.

According to some aspects the laser facete is arranged closer to the first component than to the second component. This can result in particular from the fact that laser diode is in terms of a laser package known in the art a downward directed laser diode with its active region closer to the bottom surface of the laser diode than to the opposing top surface. However, by rotating the laser diode by 90° the active region is located closer to one of the side walls of the laser diode than to the opposing other side wall and thus closer to either the first or the second component than to the other.

According to some aspects the laser package further comprises an optical element arranged within the beam path of the laser radiation emitted by the laser diode. The optical element can in particular be arranged on the top surface of the base plate being configured to deflect the laser radiation emitted by the laser diode in particular by 90°. However, a deflection of the laser radiation with an angle different to 90° is of course also conceivable. The optical element can therefore for example be formed by a prism.

According to some aspects the laser diode is arranged between the first and the second component with a predefined vertical spacing to the baseplate such that the laser radiation emitted by the laser diode does not impinge on the baseplate within a predefined horizontal distance from the front surface. The arrangement of the laser diode between the first and the second component can thus be called floating, as the laser diode is not in direct contact with the base plate but vertically spaced to it. By this and in particular by adapting the vertical spacing, a beam clipping within the predefined horizontal distance can be prevented.

According to some aspects the first and the second component each comprise a thickness greater than a width of the laser diode. Thus, the laser diode can on the one hand contact the first and the second component along the whole width of the laser diode for a good heat dissipation and a desired vertical spacing of the laser diode to the baseplate can be achieved. By the term width, in particular the extension of the laser diode in the same direction as the fast axis is meant.

According to some aspects the first and the second component each have a high thermal conductivity, in particular a thermal conductivity greater than 350W/mK. For example, the first and the second component can be made of copper, which has a thermal conductivity of around 380W/mK. In comparison, a ceramic base substrate of a classic submount made of a ceramic material such as aluminium nitride (AlN), for example, has a thermal conductivity of approximately 180 W/mK.

According to some aspects a first side surface of the laser diode is electrically connected to a first side surface of the first component and a second side surface of the laser diode, opposite the first side surface, is electrically connected to a first side surface of the second component. The electrical connection can thereby each be formed by means of a sintering paste, a bonding material, an electrically conductive adhesive, or a connecting material comprising conductive nanowires. The laser diode can be attached to the components by thermocompression bonding, a sintering process or a soldering process. For example, gold-tin (AuSn) solder compound, a silver (Ag) or gold (Au) sinter paste, or gold (Au) as a contact material for a gold-gold (AuAu) interface can be used as materials.

According to some aspects the laser package further comprises a second laser diode, wherein the second laser diode is arranged between the second and a third thermally and electrically conductive component. The third component is thereby arranged on a third contact layer being arranged on the top surface of the baseplate. The laser diodes are in particular electrically connected in series but can also be connected in parallel or separate from each other. However, the components serve in any case as heat sinks for the laser diodes to transport the heat generated in the laser diodes during operation out of the laser package. The laser package can according to some aspects be expanded further in the same way as described by for example 1, 2, 3, 4 or more laser diodes, thermally and electrically conductive components as well as contact layers.

According to some aspects the laser package further comprises contact vias through the baseplate to provide electrical terminals on a bottom surface opposite the top surface of the baseplate. Via the electrical terminals, the laser package can for example be electrically supplied or controlled from the outside. On the other hand, the heat generated in the laser package during operation can be transported out of the laser package via the terminals.

According to some aspects the baseplate comprises an electrically insulating material, and in particular is formed by a circuit board.

According to at least one embodiment a method for manufacturing a laser package comprises the steps:

Providing a baseplate with a first contact layer and a second contact layer arranged on a top surface of the baseplate;

Attaching a first laser diode, in particular high power laser diode, between a first and a second thermally and electrically conductive component, such that a first side surface of the laser diode is electrically connected to a first side surface of the first component, a second side surface of the laser diode, opposite the first side surface, is electrically connected to a first side surface of the second component, and a front surface of the laser diode protrudes front surfaces of the components; and

Arranging the first component and the second component with the first laser diode between the first and the second component on the first and second contact layer such that the first component is arranged on the first contact layer and the second component is arranged on the second contact layer.

The laser diode is thereby configured to emit laser radiation through a laser facete arranged on the front surface with a beam profile which is non-rotationally symmetric having a fast axis and a slow axis perpendicular to the fast axis, wherein the fast axis is oriented in parallel to the top surface of the baseplate and the slow axis is oriented perpendicular to the top surface of the baseplate.

According to some aspects the step of attaching the first laser diode comprises compression bonding, sintering, gluing or soldering the first laser diode between the first and the second component.

According to some aspects the step of arranging the first component and the second component with the first laser diode between the first and the second component on the first and second contact layer comprises a compression bonding, sintering, gluing or soldering.

According to some aspects the method further comprises a step of arranging an optical element, in particular an optical element configured to deflect the light emitted by the laser diode, within the beam path of the laser radiation emitted by the laser diode. Wherein the step comprises in particular an arranging of the optical element on the top surface of the base plate within the beam path of the laser radiation emitted by the laser diode.

According to some aspects the method further comprises a step of attaching a second laser diode between the second component and a thermally and electrically conductive third component such that a first side surface of the second laser diode is electrically connected to a second side surface of the second component, opposite the first side surface, a second side surface of the second laser diode, opposite the first side surface, is electrically connected to a first side surface of the third component, and a front surface of the second laser diode protrudes front surfaces of the second and third component. The step of attaching the second laser diode is thereby in particular be performed after the step of attaching the first laser diode.

Brief description of the drawings

In the following, embodiments of the invention will be explained in more detail with reference to the accompanying drawings. It is shown schematically in

Fig. 1A	an isometric view of a laser package,
Fig. 1B and Fig. 1C	an isometric view and a front view of a sub-component of a laser package
Fig. 2A to 2C	an isometric view, an explosive view, and a front view of a laser package according to some aspects of the invention,
Fig. 3	a front view of a further embodiment of a laser package according to some aspects of the invention,
Fig. 4	an isometric view of a further embodiment of a laser package according to some aspects of the invention, and
Fig. 5	steps of a method for manufacturing a laser package according to some aspects of the invention.

Detailed description

The present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments of the disclosure are shown. The disclosure may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided for thoroughness and completeness. Like reference characters refer to like elements throughout the description. The drawings are not necessarily to scale and certain features may be exaggerated in order to better illustrate and explain the exemplary embodiments of the present disclosure.

Fig. 1A shows a laser package comprising four laser diodes 2 each arranged on a submount 3 and in each of whose beam path an optical element 4 is arranged. The four submounts 3 as well as the four optical elements 4 are arranged on a base substrate 5 serving as the baseplate of the laser package. The p- or the n-side of the laser diodes is each arranged on a submount 3 and is electrically as well as thermally connected with the same whereas the other opposing p- or n-side is each electrically connected by means of wire bonds 6 to the neighbouring submount 3 or the base substrate 5. The optical elements 4 are each configured, to deflect the light emitted by the laser diodes 2 in particular by 90° and are in particular formed as prisms.

The laser package further comprises a transient-voltage-suppression (TVS) diode 7 arranged on the base substrate 5. The TVS diode is thereby in particular configured to protect the electronics of the laser package from voltage spikes induced on connected wires. The laser diodes 2 as well as the submounts 3 and optical elements 4 are further surrounded by a frame 8 which is arranged on the base substrate 5. On the frame 8, a not shown transparent cover can be arranged, housing the laser diodes 2 as well as the submounts 3 and optical elements 4 and protecting them from external influences.

With the design shown in Fig. 1A it is difficult, in particular when using high power laser diodes, to provide a good heat dissipation for the heat generated by the laser diodes 2 during operation. On the one hand a proper heat dissipation is only possible via one of the two contact surfaces of the laser diodes 2 namely the one facing the submount 3, and on the other hand the many different materials and especially the many different thermal interfaces between the laser diode 2 and the base substrate 5 make it difficult to achieve a good heat dissipation of the laser package.

Fig. 1B and 1C show an isometric view and a front view of a subcomponent of the laser package of Fig. 1A. The sub-component comprises a submount 3 and a laser diode 2 arranged on the submount 3 respectively on a metallization layer 9 on the submount 3. The laser diode 2 is configured to emit light L in form of a light cone through a laser facet arranged on a front surface of the laser diode 2 in a horizontal direction H. The beam profile of the light cone emitted by the laser diode is as shown in the two figures non-rotationally symmetric with an oval or elliptic cross section having a fast axis X_1 and a slow axis X_2 perpendicular to the fast axis X_1. The fast axis X_1 is thereby oriented in the vertical direction V, whereas the slow axis is oriented in lateral direction Y and thus perpendicular to the horizontal direction H and the vertical direction V.

With increasing horizontal distance from the laser diode 2 light cone emitted by the laser diode diverges faster along the fast axis X_1 of the light cone L than along the slow axis X_2 of the light cone, thus the fast axis X_1 increases faster compared to the slow axis X_2 with increasing horizontal distance from the laser diode 2. The height of the submount thus in particular serves, to prevent the light cone being clipped within a defined horizontal distance from the laser diode 2 by impinging on the base substrate 5. A way to prevent clipping is hence to increase the height of the sub-mount 3 and to arrange an optical element 4 on the base substrate 5 within the defined horizontal distance from the laser diode 2 to deflect the light emitted by the laser diode before it is clipped by the base substrate 5. However, in some application it is desired, to reduce the overall height of the laser package while still providing the same technical properties.

To overcome the aforementioned problems of the bad heat dissipation and the risk of beam clipping when reducing the height of the laser package, the inventor proposes an enhanced laser package 1 as for example shown in Fig. 2A to 2C.

The laser package 1 according to Fig. 2A to 2C dispenses in contrast to the laser package of Fig. 1A the submount but arranges the laser diode 2 “floating” between a first and a second thermally and electrically conductive component 10, 11 on a first and a second contact layer 12, 13 respectively on a top surface 5a of a base plate 5. Floating in this case means that the laser diode 2 is arranged distant from the top surface 5a of the base plate 5 not being in direct contact with it. The laser diode 2 is thereby compared to the laser diode of Fig. 1A, 1B and 1C rotated by 90° such that their electrical contacts are no longer arranged on the two surfaces opposite in the vertical direction V but on the two surfaces opposite in the lateral direction Y. The beam profile of the light cone emitted by the laser diode 2 is thus as shown in the figures non-rotationally symmetric with an oval or elliptic cross section having a fast axis X_1 and a slow axis X_2 perpendicular to the fast axis X_1, where the fast axis X_1 is oriented in the lateral direction Y and the slow axis is oriented in vertical direction V. The light cone emitted by the laser diode 2 diverges thus slower in the vertical direction V compared to the light cone emitted by the laser diode of Fig. 1A to 1C so that the effect of beam clipping is less critical. The vertical distance of the laser diode 2 to the top surface 5a of the base plate 5 can be adjusted by means of the thickness of the two components 10, 11 as well as by the vertical position of the laser diode 2 between the two components 10, 11. Depending on the application, the height of the laser package can thus be adjusted while still reducing the effect of beam clipping.

The two thermally and electrically conductive components 10, 11 in addition serve as two heat sinks, each electrically as well as thermally connected to a side surface of the laser diode 2. The two components 10, 11 are for better heat dissipation of the heat generated within the laser diode 2 during operation connected to the side surfaces of the laser diode 2 along essentially the whole horizontal length of the laser diode 2. Only a small portion of the side surfaces protrudes the two components 10, 11, in particular such that a laser facet 14 arranged on or in a front surface of the laser diode 2 protrudes front surfaces of the two components 10, 11 in the horizontal direction H.

The two components 10, 11 are in particular made of copper, to on the one hand serve as a good electrical contact for the laser diode 2 and on the other hand serve as good thermal conductive heat sinks. The heat transported away from the laser diode 2 via the two components 10, 11 can spread into the two components 10, 11 and from there spread into the two contact layers 12, 13 on which the two components 10, 11 are arranged respectively. From there the dissipated heat can be transported to the substrate and then out of the laser package.

The interconnect between the laser diode 2 and the two components 10, 11 (not shown) as well as the interconnect between the two components 10, 11 and the first and a second contact layer 12, 13 respectively (not shown) can each be formed by means of a sintering paste, a bonding material, an electrically conductive adhesive, or a connecting material comprising conductive nanowires.

Fig. 3 shows a front view of a further embodiment of a laser package 1. The laser package 1 is compared to the laser package of Fig. 2A to 2C expanded by one more laser diode 2, a third thermally and electrically conductive component 15 and a third contact layer 16. The additional laser diode 2 is arranged floating between the second component 11 and the third component 15 and the third component 15 is arranged on the third contact layer 16 on the top surface 5a of the base plate 5. The laser diodes are in particular electrically connected in series but can also be connected in parallel or separate from each other. However, the three components 10, 11, 15 serve in any case as heat sinks for the laser diodes 2 to transport the heat generated in the laser diodes 2 during operation out of the laser package 1. The laser package as shown in Fig. 3 can be expanded further in the same way as described by for example 1, 2, 3, 4 or more laser diodes, thermally and electrically conductive components as well as contact layers.

Fig. 4 shows an isometric view of a further embodiment of a laser package 1. The laser package 1 is compared to the laser package of Fig. 2A to 2C expanded by an optical element 4. The optical element 4 is arranged on the top surface 5a of the base plate 5 in the beam path of the laser diode 2 and is configured to deflect the light emitted by the laser diode 2 in particular by 90°. For example, the optical element 4 is formed by a prism. With the design shown in Fig. 4 it is possible to reduce the overall height of the laser package 1 compared to the laser package shown in Fig. 1A while still providing a laser package with 90° beam deflection. It is also possible to move the optical element 4 close to the laser diode 2 up to that point, where the light cone emitted by the laser diode 2 and deflected by the optical element 4 gets clipped by the laser diode 2 itself or the first and the second thermally and electrically conductive component 10, 11 after being deflected.

Fig. 5 shows steps of a method for manufacturing a laser package according to some aspects of the invention. In a first step S1 a baseplate with a first contact layer and a second contact layer arranged on a top surface of the baseplate is provided. In a following step S2 a first laser diode is attached between a first and a second thermally and electrically conductive component, such that a first side surface of the laser diode is electrically connected to a first side surface of the first component, a second side surface of the laser diode, opposite the first side surface, is electrically connected to a first side surface of the second component, and a front surface of the laser diode protrudes front surfaces of the components. The first component and the second component with the first laser diode between the first and the second component is then in a step S3 arranged on the first and second contact layer such that the first component is arranged on the first contact layer and the second component is arranged on the second contact layer. The laser diode attached between the first and second component is thereby in particular configured to emit laser radiation through a laser facete arranged on the front surface with a beam profile which is non-rotationally symmetric having a fast axis and a slow axis perpendicular to the fast axis, the fast axis being oriented in parallel to the top surface of the baseplate and the slow axis being oriented perpendicular to the top surface of the baseplate.

LIST OF REFERENC SIGNS

1	laser package
2	laser diode
3	submount
4	optical element
5	base plate
5a	top surface
6	wire bond
7	TVS diode
8	frame
9	metallization layer
10	first component
11	second component
12	first contact layer
13	second contact layer
14	laser facete
15	third component
16	third contact layer
L	light
H	horizontal direction
V	vertical direction
Y	lateral direction
X_1	fast axis
X_2	slow axis
S1…S3	Steps

CLAIMS

1. A laser package (1) comprising:

a baseplate (5) with a first contact layer (12) and a second contact layer (13) arranged on a top surface (5a) of the baseplate (5);

a first laser diode (2), in particular high power laser diode, arranged between a first and a second thermally and electrically conductive component (10, 11), the first component (10) being arranged on the first contact layer (12) and the second component (11) being arranged on the second contact layer (13), wherein the first laser diode (2) is configured to emit laser radiation (L) through a laser facete (14) arranged on a front surface of the laser diode (2), the front surface protruding front surfaces of the components (10,11); and

an optical element (4) arranged within the beam path of the laser radiation (L) emitted by the laser diode (2);

wherein the laser radiation (L) has a beam profile which is non-rotationally symmetric having a fast axis (X_1) and a slow axis (X_2) perpendicular to the fast axis (X_1), the fast axis (X_1) being oriented in parallel to the top surface (5a) of the baseplate (5) and the slow axis (X_2) being oriented perpendicular to the top surface (5a) of the baseplate (5); and

wherein the optical element (4) is configured to deflect the laser radiation (L) emitted by the laser diode (2), and wherein the optical element (4) is formed in particular by a prism.

2. The laser package according to claim 1, wherein the laser facete (14) is arranged closer to the first component (10) than to the second component (11).

3. The laser package according to any one of the preceding claims, wherein the laser diode (2) is arranged between the first and the second component (10, 11) with a predefined vertical spacing to the baseplate (5) such that the laser radiation (L) emitted by the laser diode (2) does not impinge on the baseplate (5) within a predefined horizontal distance from the front surface of the laser diode (2).

4. The laser package according to any one of the preceding claims, wherein the first and the second component (10, 11) each comprise a thickness greater than a width of the laser diode (2).

5. The laser package according to any one of the preceding claims, wherein the first and the second component (10, 11) each have a high thermal conductivity, in particular a thermal conductivity greater than 350W/mK.

6. The laser package according to any one of the preceding claims, wherein a first side surface of the laser diode (2) is electrically connected to a first side surface of the first component (10) and a second side surface of the laser diode (2), opposite the first side surface, is electrically connected to a first side surface of the second component (11), wherein the electrical connection is each formed by means of a sintering paste, a bonding material, an electrically conductive adhesive, or a connecting material comprising conductive nanowires.

7. The laser package according to any one of the preceding claims, further comprising a second laser diode (2), wherein the second laser diode is arranged between the second and a third thermally and electrically conductive

component (11, 15), the third component (15) being arranged on a third contact layer (16) being arranged on the top surface (5a) of the baseplate (5).

8. The laser package according to any one of the preceding claims, further comprising contact vias through the baseplate (5) to provide electrical terminals on a bottom surface opposite the top surface (5a) of the baseplate (5).

9. The laser package according to any one of the preceding claims, wherein the baseplate (5) comprises an electrically insulating material, and/or is in particular formed by a printed circuit board.

10. A method for manufacturing a laser package (1) comprising the steps:

Providing a baseplate (5) with a first contact layer (12) and a second contact layer (13) arranged on a top surface (5a) of the baseplate (5);

Attaching a first laser diode (2), in particular high power laser diode, between a first and a second thermally and electrically conductive component (10, 11), such that a first side surface of the laser diode (2) is electrically connected to a first side surface of the first component (10), a second side surface of the laser diode (2), opposite the first side surface, is electrically connected to a first side surface of the second component (11), and a front surface of the laser diode (2) protrudes front surfaces of the components (10, 11);

Arranging the first component (10) and the second component (11) with the first laser diode (2) between the first and the second component (10, 11) on the first and second contact layer (12, 13) such that the first component (10) is arranged on the first contact layer (12) and

the second component (11) is arranged on the second contact layer (13);
wherein the laser diode (2) is configured to emit laser radiation (L) through a laser facete (14) with a beam profile which is non-rotationally symmetric having a fast axis (X_1) and a slow axis (X_2) perpendicular to the fast axis (X_1), the fast axis (X_1) being oriented in parallel to the top surface (5a) of the baseplate (5) and the slow axis (X_2) being oriented perpendicular to the top surface (5a) of the baseplate (5); and

Arranging an optical element (4), in particular an optical element configured to deflect the laser radiation (L) emitted by the laser diode (2), within the beam path of the laser radiation (L) emitted by the laser diode (2).

11. The method according to claim 10, wherein the step of attaching the first laser diode (2) comprises compression bonding, sintering, gluing or soldering the first laser diode (2) between the first and the second component (10, 11).

12. The method according to claim 10 or 11, wherein the step of arranging the first component (10) and the second component (11) with the first laser diode (2) between the first and the second component (10, 11) on the first and second contact layer (12, 13) comprises a compression bonding, sintering, gluing or soldering.

13. The method according to any one of claims 10 to 12, further comprising a step of attaching a second laser diode (2) between the second component (11) and a thermally and electrically conductive third component (15) such that a first side surface of the second laser diode (2) is electrically connected to a second side surface of the second component (11), opposite the first side

surface, a second side surface of the second laser diode (2), opposite the first side surface, is electrically connected to a first side surface of the third component (15), and a front surface of the second laser diode (2) protrudes front surfaces of the second and third component (11, 15), wherein the step of attaching the second laser diode is performed after the step of attaching the first laser diode.

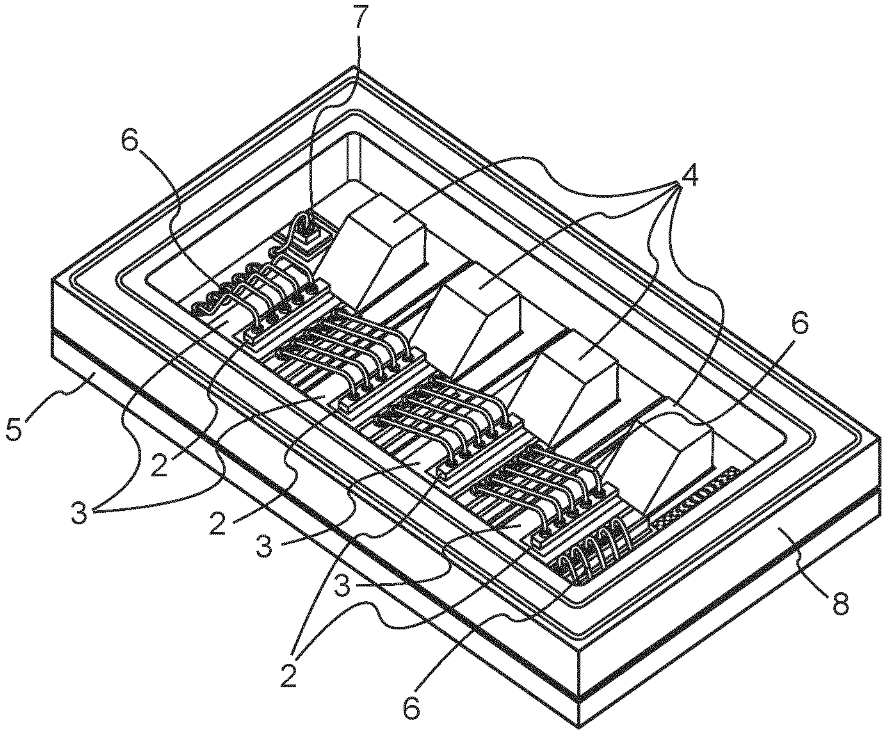

FIG. 1A

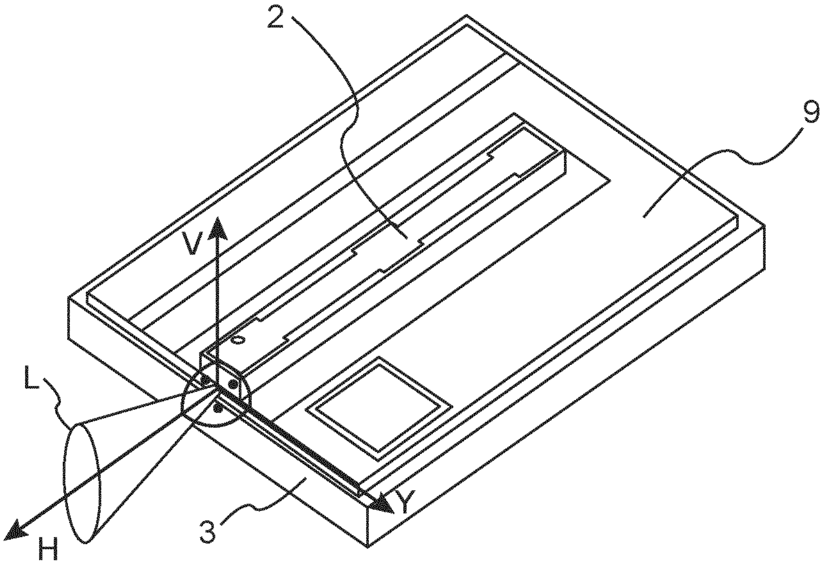

FIG. 1B

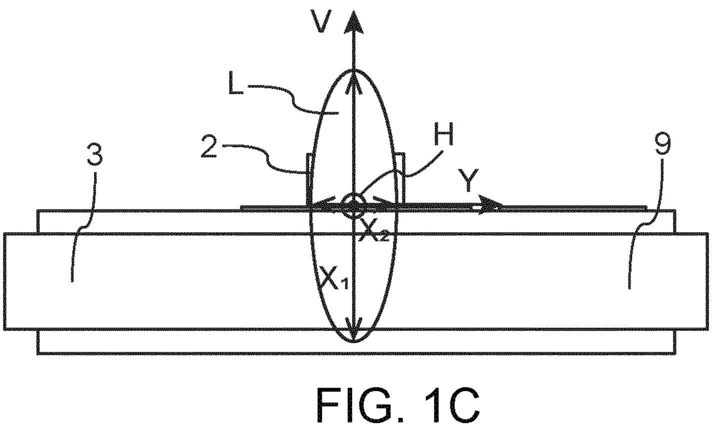

FIG. 1C

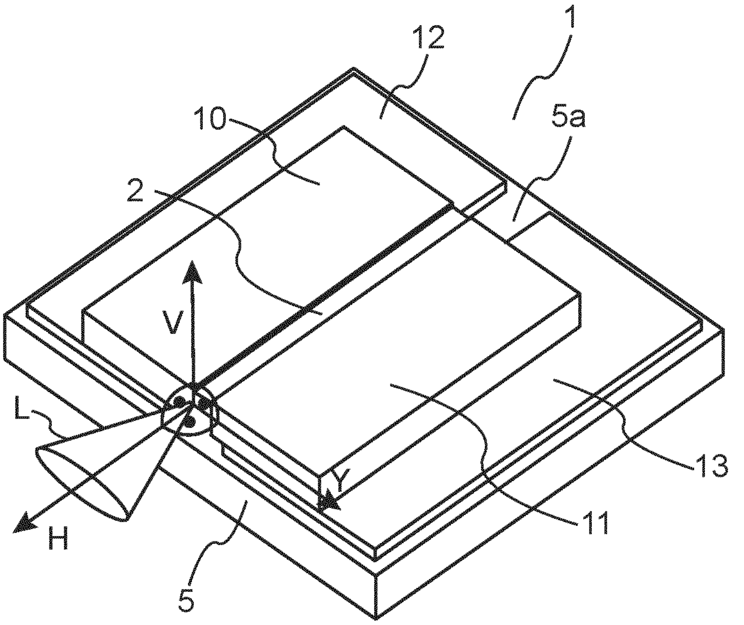

FIG. 2A

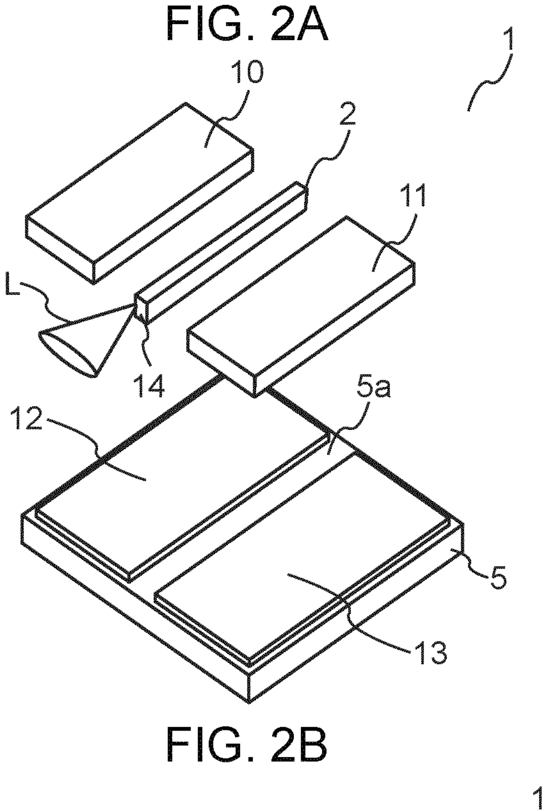

FIG. 2B

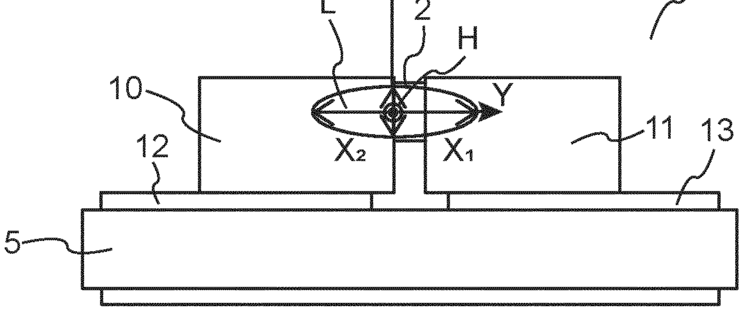

FIG. 2C

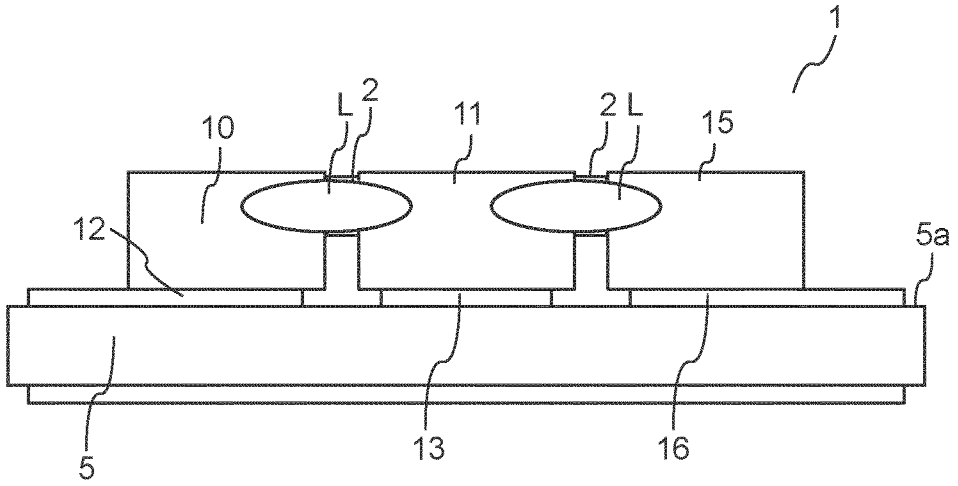

FIG. 3

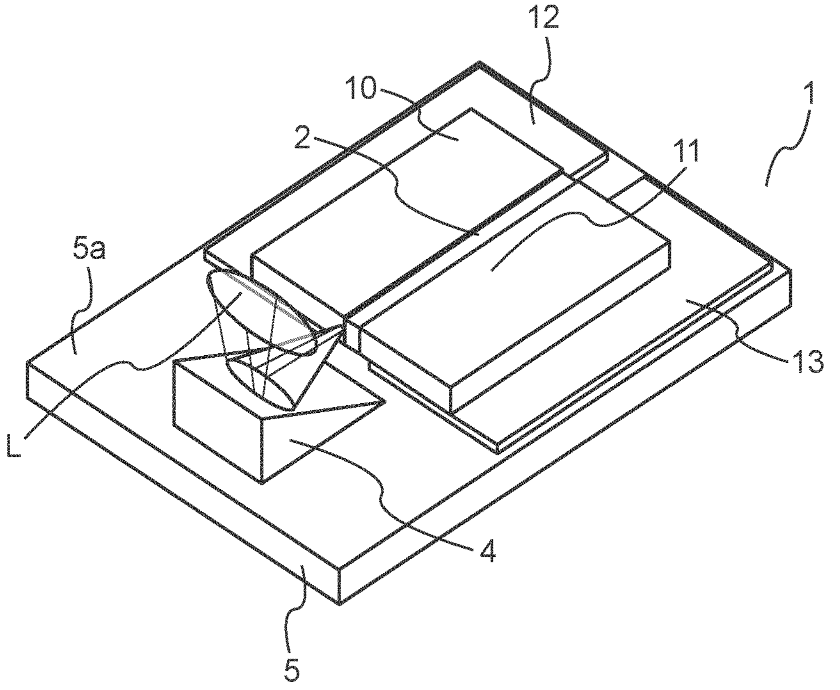

FIG. 4

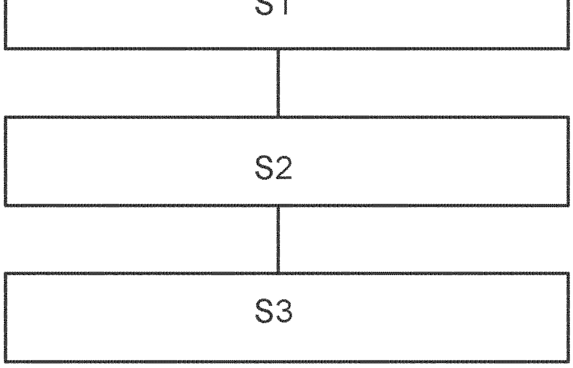

FIG. 5